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Nutritional and Organoleptic Value in the Formula Enteral of *Growol* and Germinated Mung Bean Flour as an Alternative Enteral Type 2 Diabetes Mellitus

Kandungan Gizi dan Uji Organoleptik Formula Enteral Tepung Growol dan Kecambah Kacang Hijau sebagai Alternatif Enteral Diabetes Melitus Tipe 2

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) is a metabolic disease characterized by increased blood glucose. Nutritional support rich in dietary fiber and high protein can stimulate insulin secretion, thereby inhibiting increased blood glucose. Enteral of *Growol*-Germinated Mung Bean Flour (ENGROCAJO) is a formula developed from *growol* flour and germinated mung bean flour. It contains high dietary fiber with protein and is an alternative nutritional therapy for people with T2DM. Hospital Diabetes Mellitus (DM) enteral formula administered to patients is limited to dietary fiber.
Objectives: This study aimed to analyze the nutritional value and organoleptic value of the ENGROCAJO formula and compare it with the hospital DM enteral formula.
Methods: This was an observational laboratory study developed an enteral formula from *growol* and germinated mung bean flour. It analyzed the nutritional value using proximate and dietary fiber analysis. The organoleptic assessment utilized a hedonic test with 20 participants. The nutritional and organoleptic contents were compared with hospital DM enteral formula. The difference test between formulas was tested using Kruskal-Wallis with a significant value of $p<0.05$.
Results: The nutritional content in 100 g of ENGROCAJO formula and hospital DM enteral formula includes energy of 386.86 and 329.49 kcal, protein of 41.38% and 20.43%, fat of 2.78% and 8.88%, carbohydrate of 49.08% and 38.55% with dietary fiber of 22.43% and 3.62%. Organoleptic assessment of aroma, color, flavor, and thickness showed that the ENGROCAJO formula had higher quality than the hospital DM enteral formula. However, the flavor aspect showed significant difference ($p=0.038$).
Conclusions: ENGROCAJO formula contains higher protein and dietary fiber compared to the hospital DM enteral formula. There was a significant difference in the organoleptic taste between the ENGROCAJO formula and the hospital DM enteral formula.

INTRODUCTION

Diabetes Mellitus (DM) is a chronic condition characterized by high blood glucose levels caused by a lack of insulin secretion. Insulin is a hormone produced by pancreatic cells and functions in the body's use and storage of carbohydrates, proteins, and fats. The inability of the pancreas to produce insulin affects the occurrence of hyperglycemia or increased blood glucose levels[1]. Diabetes mellitus is one of the biggest causes of death in the world. In 2021, the International Diabetes Federation (IDF) released data indicating that the global prevalence of diabetes in the world is 537 million people, and by 2045, it is projected to increase by 46% to 783 million people. Meanwhile, Indonesia is ranked 5th among countries with the highest number of diabetes cases in 2021, with 19.5 million people out of a total population of 273.8 million people It is projected to increase to 28.6 million people by 2045[2]. The prevalence of diabetes in Indonesia is determined based on data from the Basic Health Research (Riset Kesehatan Dasar or RISKESDAS), with blood tests following the consensus of The Indonesian Society of Endocrinology (Perkumpulan Endokrinologi Indonesia or PERKENI), in the population aged 15 and above in 2018, which stood at 8.5% and increased from 2013, namely 6.9%[3].

The classification of Diabetes Mellitus (DM) according to the American Diabetes Association (ADA) is divided into Type 1 Diabetes Mellitus (T1DM) (autoimmune β cell damage), Type 2 Diabetes Mellitus (T2DM) (decreased insulin secretory ability of β cells), Gestational Diabetes Mellitus (diabetes during pregnancy), and certain types of diabetes mellitus (due to other causes)[4]. Type 2 Diabetes Mellitus (T2DM) is the most common type of diabetes with the most significant

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number, counting to 90-95% of all DM cases. Triggers for T2DM include unhealthy lifestyle changes such as lack of physical activity, high consumption of carbohydrate and fat rich food, and insufficient consumption of fruit and vegetables[5]. In the long term, these lifestyle changes cause insulin resistance, which means the body's insulin-targeted cells cannot respond appropriately. Insulin resistance, if not compensated by a reduction in pancreatic β cells in secreting insulin eventually manifests clinically as hyperglycemia[5,6]. If this condition persists for a long time, there is a risk of chronic complications such as disorders of the cardiovascular system, liver disease, cancer, obesity, retinopathy, and cerebrovascular disease[4,7–12].

People with DM need to control their blood glucose levels to prevent significant increases in blood glucose levels and avoid worsening their condition. DM treatments based on PERKENI consist of pharmacological and non-pharmacological therapy. Pharmacological therapy includes taking oral and injectable antidiabetic drugs. In contrast, non-pharmacological therapy involves increasing physical activity, reducing salt consumption, quitting smoking, and a diet high in fiber, adequate protein, and low in fat and carbohydrates[13]. Diet management involves increasing the consumption of fruit, vegetables, and other natural foods such as *growol* and germinated mung beans.

Growol, a typical traditional food typical of Kulonprogo (Special Region of Yogyakarta), is a product of fermented cassava prepared by soaking, molding, and steaming. The soaking process during cassava fermentation is carried out by probiotic lactic acid bacteria, namely *Lactobacillus plantarum* and *Lactobacillus rhamnosus*[14–16]. This fermentation process produces prebiotic compounds indicated by a positive prebiotic activity score, suggesting that *growol* has the potential to be a functional food product. Functional food serves a primary function of fulfilling nutritional needs, a secondary function of being appealing to the human senses, and a tertiary function of preventing or minimizing the development of a disease[14]. Previous research shows that *growol* can increase insulin levels and reduce blood glucose levels. *Growol* as a functional food contains dietary fiber. Dietary fiber works by absorbing fluids in the digestive tract, causing the digested food to thicken, resembling a gel-like substance. The thicker digested food then slows down the digestive process, which delays the absorption of glucose into the bloodstream and is able to prevent hyperglycemia. Moreover, in addition to fiber, flavonoids found in *growol* function to stimulate insulin sensitivity and release insulin secretion from beta cell in the pancreas. Thus, it helps in increasing blood insulin levels[17].

Fermentation in the production of *growol* can hydrolyze the starch content into reducing sugars, oligosaccharides or dextrin. It is also results in undigested resistant starch and reduces the levels of reducing sugars and sucrose. Previous studies showed that *growol* experienced an increase in carbohydrate content, total dietary fiber, non-water-soluble dietary fiber, and water-soluble dietary fiber, as well as a decreased in total sugar, reduction sugar and sucrose from cassava. The changed *growol* nutrients then function in diet therapy to treat degenerative diseases such as diabetes mellitus[16,18,19]. *Growol* flour has a carbohydrate content of 95.34%, protein of 0.36%, sugar of 0.23%, sucrose of 0.02%, flavonoid levels of 6.8 mg, and 37.2% antioxidant activity[16,20,21]. The sugar and sucrose levels of *growol* flour is lower than that of cassava, white rice, and wheat flour. Also, 100 g of *growol* contains 13.17 g of dietary fiber and it is higher than cassava, cassava leaf, white rice, and wheat flour[16,17]. Dietary fiber is essential for individual with diabetes, as it reduces fasting blood glucose levels and the percentage of glycosylated hemoglobin (HbA1c)[22]. Meta-analysis studies show that a daily fiber intake of 15-35 g can improve glycemic control by reducing HbA1c levels, fasting blood glucose, HOMA-IR, and body weight[23]. As a functional food, *growol* can be combined with protein-rich food such as germinated mung beans. The reason for this combination is that the protein content in cassava or *growol* is very low[20,24].

Mung beans are a type of legume often consumed and recommended for people with diabetes because they are rich in protein, fiber and low in sugar. Through germination, mung beans can enhance the quality of their proteins and bioactive components. After germination, mung beans contain more functional substances and macromolecular substances are broken down into small molecules, facilitating absorption[25]. In addition, the content of protein, minerals, antioxidant capacity, flavonoids, vitamin C, and phenolics increased, while the fat content decreased[26–28]. Germinated mung beans contain essential amino acids, especially arginine, that can stimulate increased insulin secretion[20,29].

People with diabetes are recommended to combine their diet in combination with pharmacological therapy to maximize blood glucose control. However, individuals with diabetes are often reported to have insufficient food intake, so they should be given supporting food in the form of enteral formula[30]. The commercial diabetes enteral formula is known to be relatively expensive to obtain. Also, the protein and fiber contained are 10.02 g and 2.34 g per serving in commercial formula. Meanwhile, the hospital's enteral diabetes formula lacks food ingredients that contain fiber. ENGROCAJO, an enteral formula from *growol* flour and germinated mung bean flour, was developed as an initial stage of an alternative enteral fiber and protein-rich formula for individuals with diabetes. This research aimed to determine the nutritional content (energy, protein, fat, carbohydrates, dietary fiber) and organoleptic content of the ENGROCAJO formula and to compare it with the DMB1 Diet, the hospital enteral diabetes formula, to assess its potential as an alternative dietary therapy for individuals with diabetes.

METHODS

Design, Time, and Place

This research is a laboratory observational study. The treatments used included the development of a local food-based enteral formula containing *growol*-germinated mung bean flour and a hospital diabetes enteral formula (DMB1 Diet) as a comparison unit. Each formula was measured for nutritional composition and organoleptic assessment. The research site for making

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growol flour was conducted at the Laboratory of the Center for Food and Nutrition Studies at Gadjah Mada University (PSPG UGM) Yogyakarta; the Food Ingredient Science Laboratory, Poltekkes Kemenkes Malang for the production of germinated mung bean flour, the ENGROCAJO formula, and organoleptic tests; and at the Nutrition Laboratory, Universitas Airlangga, Surabaya for the analysis of nutrient composition, including energy, protein, fat, carbohydrates, and dietary fiber. The research was conducted in December 2023.

Tools and Materials

The tools used for formula development include a cabinet dryer (PT Khalifah Niaga Lantabura), grinder (Mill Powder Tech Co., Ltd.), oven (Azalea Electric Oven AMSO35RB), blender, 60 mesh filter, measuring cup, analytical balance, thermometer, pan, stove, silk, and spoon. Tools for carrying out organoleptic tests include small plastic cups and small plastic spoons, trays, stationery, and hedonic test forms. The enteral formula, known as the ENGROCAJO formula, was developed using *growol* flour and germinated mung bean flour as a dietary fiber and protein source. *Growol* (ripe, clean, and free of preservatives) was obtained from producers in Kulonprogo, Yogyakarta; *growol* flour (60 mesh), germinated mung bean was obtained after 36 hours germination (using non-Genetically Modified Organism (non-GMO) mung bean, without coloring and pesticides, and germinated mung bean flour (60-mesh). Complementary ingredients for the ENGROCAJO formula include full cream milk, sugar, and maltodextrin provided by the Nutrition Laboratory, Poltekkes Kemenkes Malang as a source of energy and fat. Meanwhile, the hospital's enteral diabetes formula refers to the enteral nutrition recipe for diabetes management at one of the hospitals called DMB1 Diet, in this case, it is a non-commercial formula. The DMB1 Diet is recommended to individuals with diabetes who require high protein diet. It consists of 60% carbohydrates, 20% fat, and 20% protein. The ingredients of DMB1 enteral nutrition include of skim milk powder, chicken eggs, powdered sugar, cornstarch, and rice bran oil. One serving of the ENGROCAJO formula is 50 g, while the hospital enteral diabetes formula is 100 g.

Making *Growol* Flour

The steamed (cooked) *growol* was obtained from local producers in Kulonprogo, Yogyakarta. *Growol* is placed in a drying cabinet for approximately 6 hours at a temperature of 80°C. The drying process aims to reduce pathogenic bacteria or microorganisms and minimize water content. The *growol* flour was ground in a grinder when it had dried. Next, *growol* flour was sieved through a 60-mesh sieve to create uniformly sized flour[16].

Making Germinated Mung Bean Flour

Germinated mung bean production from non-GMO mung bean (FINA). Mung beans (150 g) undergo a soaking process for 6 hours and germinate for 36 hours. The germinated mung beans are washed thoroughly with running water initially. Next, boil the germinated mung beans for 2 minutes, then remove and drain. Next, place it in the oven to dry for 90 minutes at a temperature of 80°C. Germinated mung beans that have been oven-dried are then blended into a powder. Germinated mung bean flour is sieved using a 60-mesh filter to obtain fine flour with a uniform size[20].

Making the ENGROCAJO Formula

Determining the ENGROCAJO formula recipe is adjusted to meet the minimum dietary requirements of individuals with diabetes based on PERKENI guidelines[13]. The ENGROCAJO formula ingredients are prepared for one serving (50 g) consisting of *growol* flour (dry, clean, no wounds, and lumps-free) (17.4 g), germinated mung bean flour (dry, clean, and lumps-free) (12.8 g), full cream milk ('Dancow FortiGro Full Cream', lumps-free, and not rancid) (14 g), sugar ('Gulaku', clean, no pebbles, and lumps-free) (3.5 g), and maltodextrin ('Maltodextrin DE 10-12', white, dry, and lumps-free) (2.3 g). The ingredients are mixed in one container and blended until evenly combined. The mixture of formula ingredients is placed in a measuring cup. Subsequently, heat the water to a temperature of 60°C. Slowly pour warm water slowly into the formula while stirring until there are no lumps. The ENGROCAJO formula is ready to be served.

Making Hospital Enteral Diabetes Formula

The process of producing a hospital enteral diabetes formula involves preparation of ingredients such as skim milk powder ('Lactona Skim', dry, and lumps-free) (50 g), chicken eggs (fresh and no damage) (30 g), powdered sugar (dry and lumps-free) (5 g), cornstarch ('maizenaku', dry, and lumps-free) (2 g), and rice bran oil ('Oryza Grace' and not rancid) (5 g). In the next step, heat the water in a pan until it boils. Then, pour the skim milk powder and powdered sugar into a pan with a low heat. Break the chicken eggs into a container and stir well. Dissolve the cornstarch in separate container with the cooked skim milk. Mix the cornstarch solution into the chicken egg mixture and stir well. The cornstarch solution and chicken eggs are mixed into a pan of skim milk. Add diet oil, then stir well until cooked and remove from heat.

Testing of Composition Nutrients

Composition nutrients were analyzed using a proximate to dietary fiber analysis and followed the latest Association of Official Agricultural Chemist (AOAC) Procedures[31]. Testing the nutritional composition for water content uses the heating method with an oven. Ash content uses dry ashing method, protein content uses the Kjedahl method, fat content uses the Soxhlet method. Carbohydrate uses by different method with formula %carbohydrate = 100% - (%water+%ash+%protein+%fat). The amount of energy is determined by calculating the total calories from protein (4 kcal/g), fat (9 kcal/g), and carbohydrates (4 kcal/g). For dietary fiber content analysis, the enzymatic-gravimetric method by Asp et al is used[32]. The dietary fiber analysis procedure includes protein hydrolysis using the pepsin enzyme, incubation for 60 minutes at 40°C and pH 1.5 and starch hydrolysis using the pancreatin enzyme, incubation for 60 minutes at 40°C and pH 6.8. Dietary fiber content is determined using the formula of Insoluble Dietary Fiber (IDF) (%) or Soluble Dietary Fiber (SDF) (%) or Total Dietary Fiber (TF) (%) = ((residue weight-protein weight in residue-ash

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weight in residue-blanko weight)/sample weight)) x 100. Composition nutrient analysis was conducted by laboratory staff at the Nutrition Laboratory, Universitas Airlangga, Surabaya.

Organoleptic Test

The formula development was carried out by conducting organoleptic testing, using a hedonic test on the ENGROCAJO formula and the hospital enteral diabetes formula to determine the preference level of each formula. The parameters in this test are the formula's aroma, color, taste, and texture. The hedonic test scale used consists of five (5) scales, which are 1 = really dislike it, 2 = dislike it, 3 = somewhat like it, 4 = like it, and 5 = really like it[33]. Panelists can provide personal opinions or evaluations regarding the formula on the form sheet. Five scales are commonly used for national standard sensory tests. The purposes of choosing five scales were to enable panelists to assess their preferences clearly and to avoid difficulties if the scale is too large. Moreover, the five scales are ideal, relatively simple, and have good sensitivity in analyzing the scores provided by panelists in the evaluation[34,35]. The panelists who participated in the hedonic test were instructed to fill out the form, to ensure that the panelists had the same perception. The panelist must have one score from each parameter for each formula. The criteria for panelists include being in good health, not allergic to eggs and milk, having undergone organoleptic tests before, and being familiar with the organoleptic test materials. The panelists for the organoleptic test were 20 semi-trained panelists, consisting of students from the Nutrition Department of the Health Polytechnic, Ministry of Health, Malang. Panelists willing to participate in organoleptic tests must fill out an informed consent. The organoleptic test was conducted in a chamber test at the Food Ingredient Science Laboratory, Poltekkes Kemenkes Malang with a proper lightning and position for each panelist.

Data Analysis

The data were analyzed by using The International Business Machines Corporation Statistical Product and Service Solutions (IBM SPSS) Statistics version 25. Data analysis consisted of univariate and bivariate analysis. Univariate analysis is conducted to determine a description of each formula's characteristics based on nutritional value. Bivariate analysis is conducted to obtain differences between formulas. The data distribution was determined using the Shapiro-Wilk test. Organoleptic data showed that the data was not normally distributed ($p<0.05$), followed by the Kruskal-Wallis bivariate test with a significant value of $p<0.05$[36].

RESULTS AND DISCUSSIONS

Formula Nutritional Content

The nutritional content analysis of the formula product was conducted to determine the levels of protein, fat, carbohydrates, total dietary fiber, water-soluble dietary fiber, and non-water-insoluble dietary fiber. After examination, the results of each nutritional content of the ENGROCAJO Formula are shown in Table 1. Meanwhile, the nutritional content of the ENGROCAJO formula compared with the hospital formula for each serving is shown in Table 2.

Table 1. Composition nutrient of the Enteral of *Growol*-Germinated Mung Bean Flour (ENGROCAJO) formula per 100 g

Composition Nutrient	Total
Energy (kcal)	386.86
Protein (%)	41.38
Fat (%)	2.78
Carbohydrate (%)	49.08
Moisture (%)	4.65
Ash (%)	2.11
Dietary Fiber	22.43
Water-Soluble Dietary Fiber (%)	2.67
Non-Water-Soluble Dietary Fiber (%)	19.76

Table 2. Comparison of composition nutrients between hospital DM enteral formula and Enteral of *Growol*-Germinated Mung Bean Flour (ENGROCAJO) formula per serving

Composition Nutrient	Hospital Enteral DM Formula (*Sonde* DMB1) (100 g/serving)	ENGROCAJO Formula (50 g/serving)
Energy (kcal)	329.49	193.43
Protein (g)	20.43	20.69
Fat (g)	8.88	1.39
Carbohydrate (g)	38.55	24.54
Dietary Fiber (g)	3.62	11.22
Water-Soluble Dietary Fiber (g)	n.d	1.34
Non-Water-Soluble Dietary Fiber (g)	n.d	9.88

n.d (not detected); DM (Diabetes Mellitus); DMB1 (Diet Diabetes Mellitus B1); ENGROCAJO (Enteral of *Growol* and Germinated Mung Bean Flour)

Proximate Analysis

Proximate analysis measures the nutritional content of protein, fat, and carbohydrates. The energy value is obtained by calculating the amount of protein, fat, and carbohydrates in kcal units. In 100 g when compared with each formula, only the fat content is

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lower in the ENGROCAJO formula. The carbohydrate and protein levels in the ENGROCAJO formula are higher because it contains carbohydrate-rich foods such as *growol* flour and maltodextrin, along with germinated mung beans as a source of protein. Based on Table 2, the energy, fat, and carbohydrate levels indicate show that the ENGROCAJO formula is lower than the hospital formula in one serving. The presentation in one serving is used differently because the ENGROCAJO formula is designed to calculate the requirements of individuals with diabetes. Meanwhile, the hospital formula only follows the hospital prescription without recalculation. The difference in content is not only caused by the net weight of the formula but also the raw materials used in the hospital formula. This raw material contained in the ENGROCAJO formula, such as chicken eggs, diet oil, cornstarch, and powdered sugar, contribute to considerable energy, fat, and carbohydrate values. It is known that in one serving, chicken eggs contain 46.2 kcal and 3.24 g of fat, diet oil contains 46.4 kcal and 5 g of fat, cornstarch contains 7.62 kcal and 1.8 g of carbohydrates, and powdered sugar contains 19.7 kcal and 4.7 g of carbohydrates[24].

The lower carbohydrate content in the ENGROCAJO formula can affect the blood glucose absorption response. The lower the carbohydrates in food, the lower the glycemic index value[37]. A low glycemic index in food will slow gastric emptying causing food suspension to reach the small intestine more slowly. This decrease in speed also slows down glucose absorption in the blood, thereby preventing a rapid increase in blood glucose[38,39]. The low-fat content can also reduce the risk of complications in patients with T2DM. The fat content in the ENGROCAJO formula is known to be within the recommendation by PERKENI, which is 20-25% of daily requirements and according to the proportion of fat in main meals (8-10 g) and snacks (3.1-3.9 g)[13].

The protein content obtained from the ENGROCAJO formula with the hospital formula for one serving, with 20.69 g and 20.43 g, respectively. Even though it does not include animal protein sources in its essential ingredients, it is known that using germinated mung bean flour can provide high protein value. The protein content in the ENGROCAJO formula in one serving (20.69 g) meets the dietary protein needs of patients with diabetes according to PERKENI regulations, which recommend 10-20% for main meals (9-18 g) and snacks (3.5-7 g)[13]. The high protein content resulting from germinated mung bean flour aligns with research by Kanetro et al., who stated that the protein quality of the composite flour made of *growol* flour and germinated mung bean flour was better than *growol* flour[20]. The protein content of germinated mung bean flour enhances the value of amino acids, particularly the essential amino acid arginine. The amino acid arginine stimulates increased insulin secretion and reduces blood glucose[40,41].

Furthermore, the high glycemic index of *growol* flour (>70) can be reduced by adding mung beans, causing it to fall into the low glycemic index category (<55)[42]. According to previous research, cassava and *growol* flour were added with various nuts, including mung beans, and experienced changes in the glycemic index value compared to those without nuts. Changes in the glycemic index may be caused by the protein content in mung beans. Protein can trigger insulin secretion without increasing blood glucose levels. Protein digestion in the body releases the hormone cholecystokinin which induces the feeling of fullness. Therefore, the higher the protein content in food, the lower the glycemic index[43,44]. Other influencing factors include the food fiber content, amylose and amylopectin levels, and starch digestibility. Cassava and its processed products like *growol* have a higher dietary fiber and amylose with lower starch digestibility, which is associated with a low glycemic index value[44]. Foods with a low glycemic index slow down the rate of glucose absorption in the blood, helping to control blood glucose levels can be controlled. Controlled blood glucose increases insulin sensitivity and improves the condition of T2DM patients so that the risk of complications will decrease[1].

Total Dietary Fiber Content

Dietary fiber is a type of carbohydrate classified as in non-available carbohydrates, which means digestive enzymes cannot digest it and provides a low glycemic index[37]. The ENGROCAJO formula contains a higher amount of dietary fiber compared to the hospital formula for one serving, namely 11.22 g and 3.62 g, respectively. These results could be due to the use of *growol* flour, which contributes to the dietary fiber content in the ENGROCAJO formula compared to the hospital formula. This study is consistent with research by Puspaningtyas et al., which demonstrates a significant disparity in the high dietary fiber content in *growol* compared to similar food ingredients such as cassava[16]. *Growol* is derived from cassava which undergoes significant changes in dietary fiber content as a result of the fermentation process by amylolytic bacteria[16,45].

The dietary fiber content in the ENGROCAJO formula meets the daily fiber requirement of T2DM patients based on PERKENI, which recommend a daily intake is around 20-35 g a day[13]. Dietary fiber is known to help regulate control blood glucose levels. The higher the dietary fiber content including soluble and insoluble fiber, the better the control over blood glucose levels. Soluble dietary fibers bypass the small intestine's digestive process and are readily fermented by the large intestine's bacteria. In general, soluble fibers lengthen the time that food passes through the humans' digestive tract, delaying the gastric emptying, and ultimately preventing the absorption of glucose[46]. Meanwhile, insoluble dietary fiber has less or no fermentation in the large intestine but it has low-density energy, increases fecal bulk, reduce appetite, and improves postprandial glucose[46,47]. Ingesting soluble and insoluble fibers can both help with glycemic control. However, recent study indicates that soluble fibers and other fermentable fibers produced by gut microbial fermentation could be beneficial for enhancing gut health, immunity, and energy metabolism[48–51]. Moreover, dietary fiber plays a role in improving insulin secretion and sensitivity in people with diabetes and reducing glycosylated hemoglobin (HbA1c) levels[1,52]. Dietary fiber in food can increase the potency of prebiotics, which helps alleviate metabolic disorders in

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T2DM patients[16,53,54].

Organoleptic Test

Organoleptic testing assesses product quality based on the five human senses, such as the sight, smell, and taste, to evaluate the product's acceptability and preference concerning aroma, color, taste, and formula texture. The organoleptic assessment was conducted with 20 semi-trained panelists. The organoleptic assessment was conducted on the developed formula, specifically the ENGROCAJO formula and the hospital diabetes enteral formula. Table 3 shows that the organoleptic test results for the ENGROCAJO formula have the highest average values in aroma, color, taste, and texture compared to the hospital diabetes enteral formula. The most difference in value is in the taste aspect, namely 0.55, followed by texture at 0.5, aroma at 0.1, and the slightest difference is in color at 0.05. Here are the results of the analysis of the organoleptic test on ENGROCAJO formula and hospital diabetes formula.

Table 3. Differences in organoleptic tests of hospital enteral diabetes formula and Enteral of *Growol*-Germinated Mung Bean Flour (ENGROCAJO) formula

Formula	Mean±SD			
	Aroma	Color	Taste	Texture
Hospital DM Enteral	3.9±0.553	4.0±0.459	3.05±0.759	2.85±0.745
ENGROCAJO	4.0±0.725	4.05±0.510	3.60±0.754	3.35±0.813
p-value	0.453	0.739	0.038*	0.055

DM (Diabetes Mellitus); ENGROCAJO (Enteral of *Growol* and Germinated Mung Bean Flour)
*Significant (p<0.05) with Kruskal-Wallis test

Aroma

Aroma assessment uses the nasal cavity's olfactory sense to evaluate the scent omitted by formulated product. The results of this test showed that the ENGROCAJO formula had a higher value than the hospital diabetes enteral formula with averages of 4.0 and 3.9, respectively. Statistical analysis of the aroma aspect was obtained at p=0.453 (p>0.05), which showed no significant difference in the two formulas. This result is possible because the aroma emitted by each formula is different. Specifically, the ENGROCAJO formula has a milk and mung bean aroma, while the hospital diabetes enteral formula has a typical milk and chicken egg aroma. These distinct aromas can influence the evaluation, making the results nearly comparable because panelists tend to have a similar preference for both distinct aromas.

Color

The color aspect is assessed using the sense of sight, specifically the eye, to determine preferences for visuals or the appearance of the formula. The organoleptic test results for color were almost comparable. Specifically, an average difference of 0.05 was observed with the ENGROCAJO formula, which was higher than the hospital diabetes enteral formula. These results were then subjected to statistical analysis. The result was found to be p=0.739, indicating no significant difference between the two formulas in terms of color aspect. The color produced in the ENGROCAJO formula is greenish white, while in the hospital diabetes enteral formula, it is light yellow. The cause of the color difference is that the essential ingredients used in each formula are different. A greenish-white color dominates the ENGROCAJO formula due to the presence of full cream milk and *growol* flour, which gives the white color, and germinated mung bean flour, which contributes to the green color. Meanwhile, the hospital's enteral formula is dominated by light yellow due to the presence of chicken eggs. Based on these results, the panelists provide scores that were fairly similar, with greenish-white was more attractive in color assessment.

Taste

Organoleptic taste testing uses the taste buds, specifically the tongue. Based on the assessment results, it was found that the ENGROCAJO formula had the highest taste value, with a difference of 0.55 compared to the hospital diabetes enteral formula. The taste test values were then analyzed statistically, and the result was p=0.038, indicating differences in the taste parameters of the two formulas. This result is because panelists prefer sweeter flavor. The comparison between the ENGROCAJO formula and the hospital diabetes enteral formula for the additional ingredients of granulated sugar in the serving is 2.5 g and 5 g, respectively. The panelists found considered the amount of sugar content in the hospital diabetes enteral formula to be excessive, which influenced their evaluation of taste parameters.

Texture

The texture of each formula is influenced by the essential ingredients used. The assessment of texture parameters is known to be more favorable for the ENGROCAJO formula, with an average difference of 0.5. This result indicates that the panelists generally flavor the texture of the ENGROCAJO formula. The panelists evaluated the texture of the hospital diabetes enteral formula as too thick. The result of the thicker formula is possible because of chicken eggs and cornstarch ingredients, which provide a denser texture compared to the ENGROCAJO formula. The results of the texture parameters of the two formulas were then analyzed statistically, and there were no significant differences (p=0.055).

CONCLUSIONS

The nutritional content in 100 g of the ENGROCAJO formula and the hospital diabetes enteral formula contains higher levels of energy, protein, and fiber. It has lower fat and carbohydrate content compared to the hospital diabetes enteral formula. The organoleptic assessment of aroma, color, taste, and texture revealed that the ENGROCAJO formula

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outperformed the hospital diabetes enteral formula, with taste being the only significantly different aspect. The ENGROCAJO formula was declared decent for development in further research because the composition of nutrients (energy, protein, fiber) and positive results from the hedonic test. Furthermore, future research can be carried out regarding the shelf life and other nutritional content, such as glycemic index and amino acid of this formula.

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AUTHOR CONTRIBUTIONS

DN: conceptualization, data curation, formal analysis, investigation, methodology, resources, supervision, writing–original draft and editing; NR: supervision, methodology and writing–review; FL: supervision, formal analysis and writing–review.

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